

WE CLAIM:

sub a1

5

1. A method of measuring pressure changes in a mammal, comprising:
application of a contrast agent containing microbubbles into said
mammal;
an ultrasound system with analog or digital filtering for detecting said
microbubbles, said ultrasound system capable of transmitting at least one ultrasound
detection signal and capable of receiving ultrasound signals that are scattered by said
microbubbles, wherein said ultrasound signals received by said ultrasound system
include at least one of the group of subharmonic and ultraharmonic signals; and
measurement of the amplitude of at least one of the group of
subharmonic and ultraharmonic signals to estimate said pressure changes in said
mammal.

10

15

2. A system for measuring pressure changes in a mammal, comprising:
an ultrasound system with analog or digital filtering for detecting microbubbles,
said ultrasound system capable of transmitting at least one detecting signal and
capable of receiving detection signals that are scattered and returned by said
microbubbles, wherein said detection signals received by said ultrasound system
include at least one of the group of subharmonic and ultraharmonic signals;
said ultrasound system having at least one single-element transducer
for pressure estimation.

20

25

3. A system for measuring pressure changes in a mammal, comprising:
an ultrasound system with analog or digital filtering for imaging microbubbles, said
ultrasound system capable of transmitting at least one detecting signal and capable of
receiving detection signals that are scattered and returned by said microbubbles,
wherein said detection signals received by said ultrasound system include at least
one of the group of subharmonic and ultraharmonic signals;

30

said ultrasound system having one of the group of a phase transducer
array with a capability of beam steering, a linear transducer array with at least one
transducer, or a curved transducer array.

24

4. An ultrasound contrast agent used for pressure estimation with said
ultrasound contrast agent containing microbubbles, wherein said microbubbles have a
narrow band of size distribution and are stable when circulating within a mammal
5 bloodstream such that size uniformity of said microbubbles is maintained during
circulation and said microbubbles are substantially compressible such that said
microbubbles change significantly in size in response to changes in pressure and said
response of said microbubbles to changes in pressure maximizes the intensity of at
least one of the group of subharmonic and ultraharmonic signals scattered from said
10 microbubbles.

5. A method of using an ultrasound contrast agent containing
microbubbles to estimate pressure change in a mammal, comprising:
application of said microbubbles, wherein said microbubbles have a narrow
15 band of size distribution and are substantially compressible such that said
microbubbles change significantly in size in response to changes in pressure;
measurement of shifts in resonance frequency of one of the group of
subharmonic or ultraharmonic signals received by an ultrasound system having
analog or digital filtering for detection of said microbubbles, wherein said resonance
20 frequency shifts result from changes in the size of said microbubbles and said size
changes correspond to changes in hydrostatic pressure.

25

30